SECTION 13

Hydrostatic Steering

Table of Contents

Operation No.	Description	Page No.
13 A . 1	Specification	13A - 3
13 A . 2	General Description	13A - 5
13 A . 3	Procedure for oil filling and air bleeding	13A - 10
13 A . 4	Steering pump removal and refitment	13A - 11
13 A . 5	Steering pump overhauling	13A - 12
13 A . 6	Steering pump failures and causes	13A - 17
13 A . 7	Steering unit removal from tractor	13A - 18
13 A . 8	Steering unit overhauling	13A - 21
13 A . 9	Drag link and tie rod overhauling	13A - 43
13 A . 10	Steering cylinder removal and refitment	13A - 43
13 A . 11	Steering cylinder overhauling	13A - 44

13A . 1 - Specification:

Oribitrol steering unit:

Make	...	Danfoss.
Type code	...	OSPJ 100 ON.
Nominal displacement	...	100 cubic centimeter per rev.
Relief valve presuure setting at 1200 engine RPM	...	140 bar (2030 psi).
Shock valve pressure setting	...	200 bar (2900 psi).
Reservior capacity	...	0.65 to 0.75 lts. (1.3 to 1.5 pts).

Special tools:

SER / 278	...	Holding tool.
SER / 279	...	Guide ring.
SER / 280	...	Assembly tool for 'O' tring and king ring.
SER / 281	...	Assembly tool for roto glyd.
SER / 282	...	Assembly tool for lip seal.
SER / 283	...	Assembly tool for cardan shaft.
SER / 284	...	Assembly tool for dust seal.
SER / 298	...	Hydraulic cylinder ball joint end cover tool.

Bolt torques:

Steering uint mounting plate bolts	...	27 lbf.ft.(36 Nm).
oribitrol mounting bolts	...	22 lbf.ft.(30 Nm).
Oribitrol relief valve plug	...	37 lbf.ft.(50 Nm).
Ball joints	...	90 lbf.ft.(122 Nm).
Clamp bolt	...	35 lbf.ft.(47 Nm).
Track adjustment bolt	...	35 lbf.ft. (47 Nm).
Ball joint nuts	...	70 lbf.ft (90 Nm).

Recommended grade of oil

BP	....	Terrac
		Autra C3 10W
		Vanellus C3 10W
		Aytran GMMP or DX III
CALTEX	....	RPM Delo 200
		Oil 10W
		Texamatic
		Fluid - (Dextron III)
CASTROL	....	Castrol II C 310
		Agricastrol ATF
		TQ dextron III
		Castrol TQ
		Type A - Suffix A
ESSO	....	Esso torque
		Fluid 46
		Essoulbe XD3 + 10W
		Esso AIF LASA
MOBIL	....	Mobil ATF 200
		Mobil ATF 220
		Mobil delvac 1310
SHELL	....	Dextron III
		Donax TF
		Rimula X 10 W
TEXACO	....	Torque fluid C3
		Ursa super
		LA SAE 10 W
		Texamatic 9226
		(Dextron III)
TOTAL	....	HTF Type C3
		Dextron III
		Rubia S 10 W

13A . 2 - GENERAL DESCRIPTION:

Hydrostatic steering:

Hydrostatic steering is a full power steering system with no mechanical connection between the steering wheel and tractor wheels. Oil is delivered from the steering pump to the orbitrol steering control unit, which when the steering wheel is turned, directs the required oil flow to the appropriate side of the steering ram(s). When the wheel is stationary the orbitrol unit allows the supply oil to return to the reservoir. The tractor can be manually steered if the power steering mechanism fails, or if the tractor is being moved without the engine running.

The orbitrol steering unit is splined onto the end of the steering column. Hydraulic tubes and hoses connect the unit to the steering ram(s) and the gear pump. The orbitrol steering unit on the small tractors with twin steering rams contains the system pressure relief valve and shock valve.

ORBITROL STEERING UNIT

Neutral Flow. Fig.1.

In the neutral position, oil flows from the hydraulic pump to the steering unit. The holes in the spool align with holes in the sleeve to direct the oil through the centre of the valve into the return flow circuit. The hydraulic lines to the ram cylinder are isolated. Two shock valves and two suction valves are fitted internally to the left and right outlet ports. The shock valve will protect the system between the ram and the orbitrol unit. The suction valve will then allow the other side of the system to compensate for any lack of oil.

Wheel Turning with EngineRunning.Fig.2.

First movement of the steering wheel moves the spool against the leaf springs. This opens the closed centre pressure port and aligns slots in the spool with holes in the sleeve, allowing oil to pass to the hand pump. Further movement of the steering wheel continues to turn the wheel, sleeve and hand pump. Simultaneously the hand pump meters the oil flow and directs it back into the sleeve and spool. The oil re-entering is then directed by slots, in the spool which align with the holes in the sleeve, to direct oil to the headside or roadside of the steering ram (the direction is controlled by steering wheel movement). The oil returning from the steering cylinder is directed, (by the slots in the spool valve aligning with holes in the sleeve) into the return line.

In the line between the inlet and the spool valve, situated internally in the orbitrol unit, is a relief valve (small tractors only). Its function is to protect the pump from excessive pressures. For example, when on full lock, or when the road wheels are against an obstruction. A check valve is fitted in the orbitrol unit in the path of the oil entering from the pump. This is a one-way valve preventing induced peak pressure generated from the road wheels returning to the main pump when steering.

Wheel Turning with EngineStopped.Fig.3.

Should the pressure from the hydraulic pump cease, it is important that steering should still be maintained. For this reason a by-pass valve is situated between the inlet and return galleries inside the orbitrol assembly. When the hydraulic pump is functioning normally, the by-pass valve is held on its seat by the oil pressure, allowing the oil to pass into the spool valve. When the pressure from the hydraulic pump drops, the oil returning from the steering cylinder is allowed to pass the by-pass valve to the inlet side of the spool valve, enabling oil to be passed from one side of the steering cylinder to the other. In this way steering control is maintained at all times.

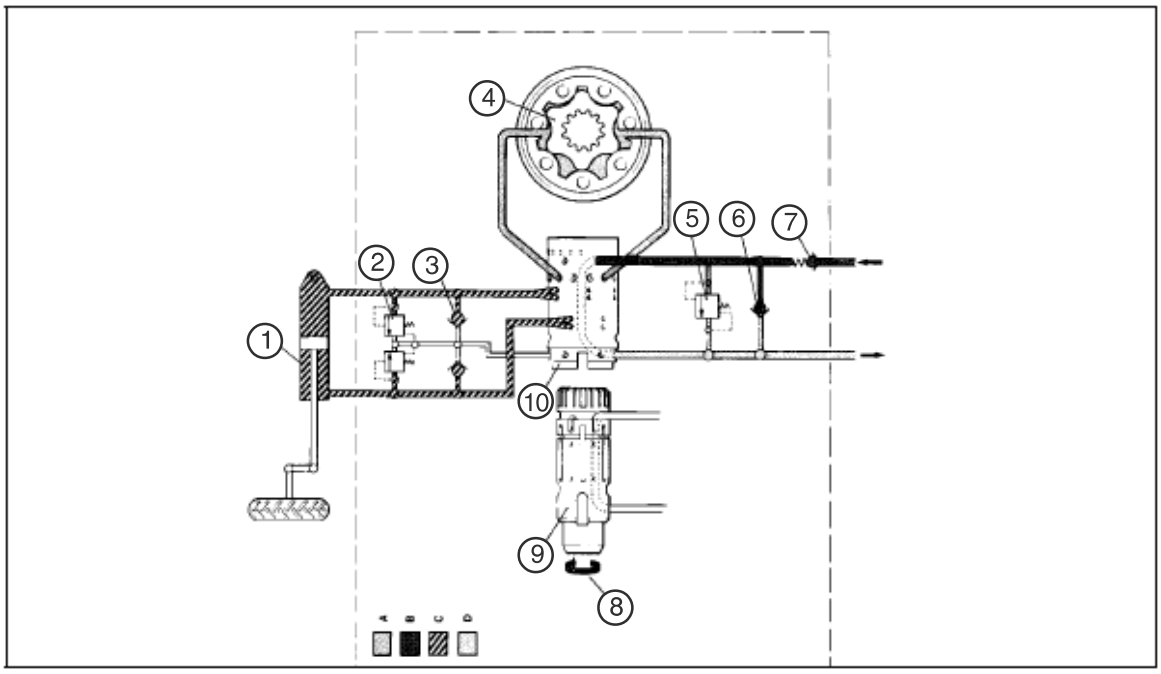


Fig. 1 Orbitrol steering unit circuit - Neutral flow

1. Steering cylinder	5. Relief valve	9. Spool valve	A. Metering valve - static oil
2. Shock valves	6. Non return valve	10. Sleeve valve	B. Pressure line
3. Suction valves	7. Check valve		C. Steering line - static oil
4. Metering valve	8. Steering wheel connection		D. Return oil

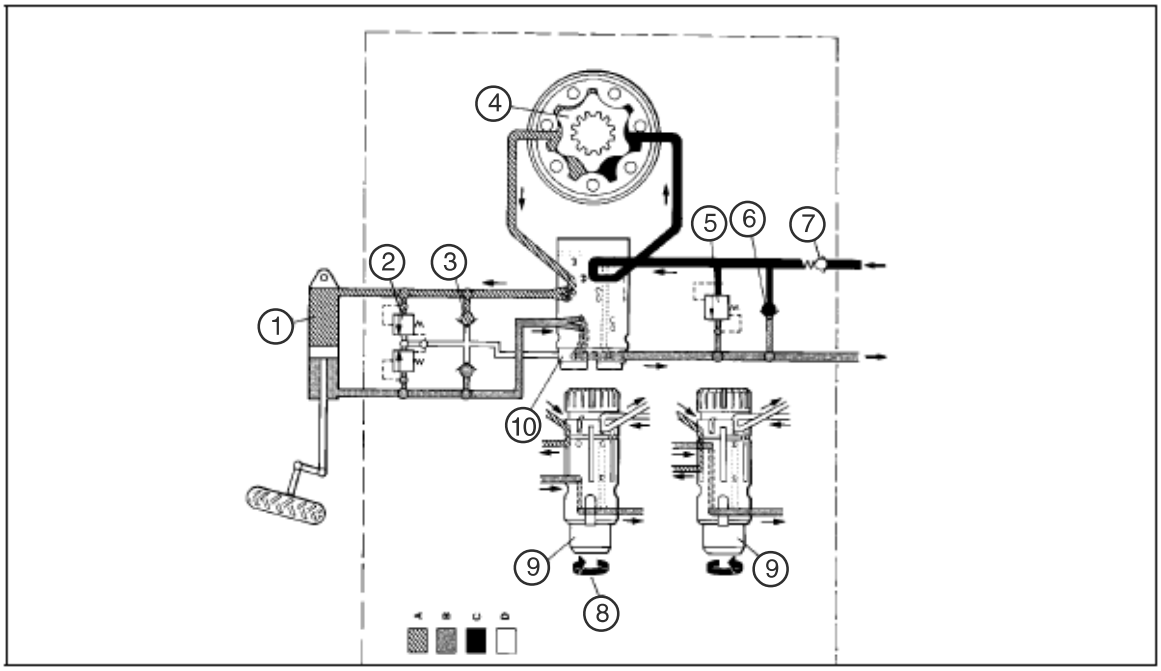


Fig. 2 Orbitrol steering unit circuit - Wheel turning with engine running

1. Steering cylinder	5. Relief valve	9. Spool valve	A. Metering valve - static oil
2. Shock valves	6. Non return valve	10. Sleeve valve	B. Pressure line
3. Suction valves	7. Check valve		C. Steering line - static oil
4. Metering valve	8. Steering wheel connection		D. Return oil

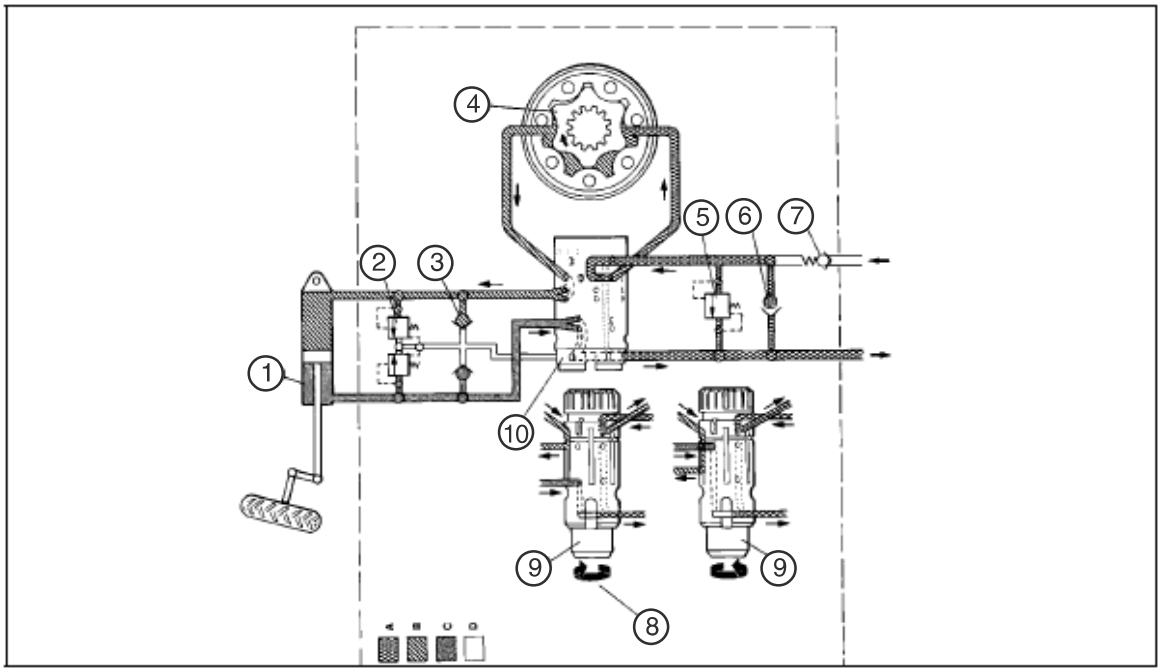


Fig.3 Orbitrol steering unit circuit - Wheel turning with engine stopped

1. Steering cylinder
2. Shock valves
3. Suction valves
4. Metering valve
5. Relief valve
6. Non return valve
7. Check valve
8. Steering wheel connection
9. Spool valve
10. Sleeve valve

A. Metering valve - static oil
B. Pressure line
C. Steering line - static oil
D. Return oil

TYPICAL STEERING LAYOUT FOR 2WD

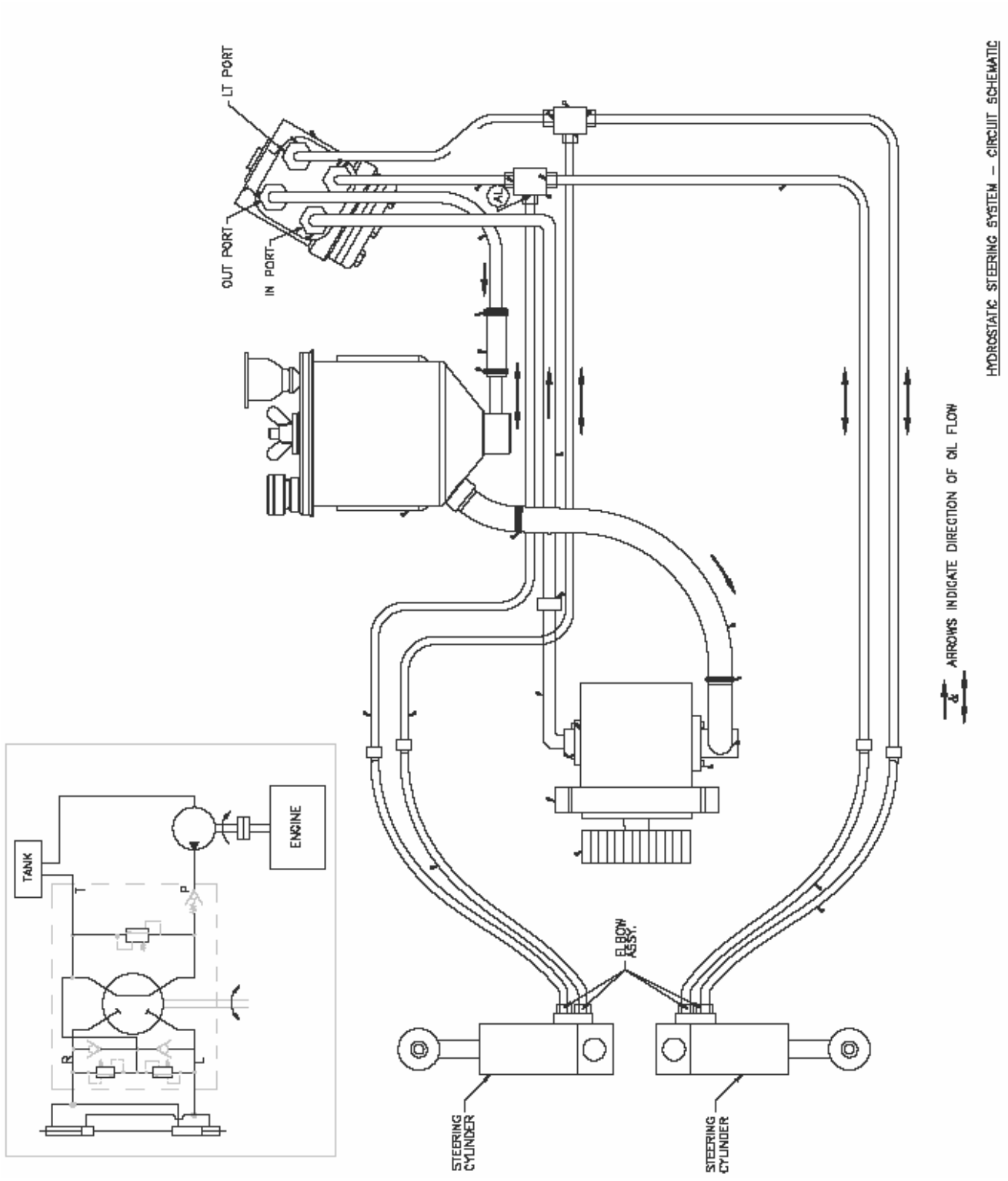


Fig 4

TYPICAL STEERING LAYOUT FOR 4WD

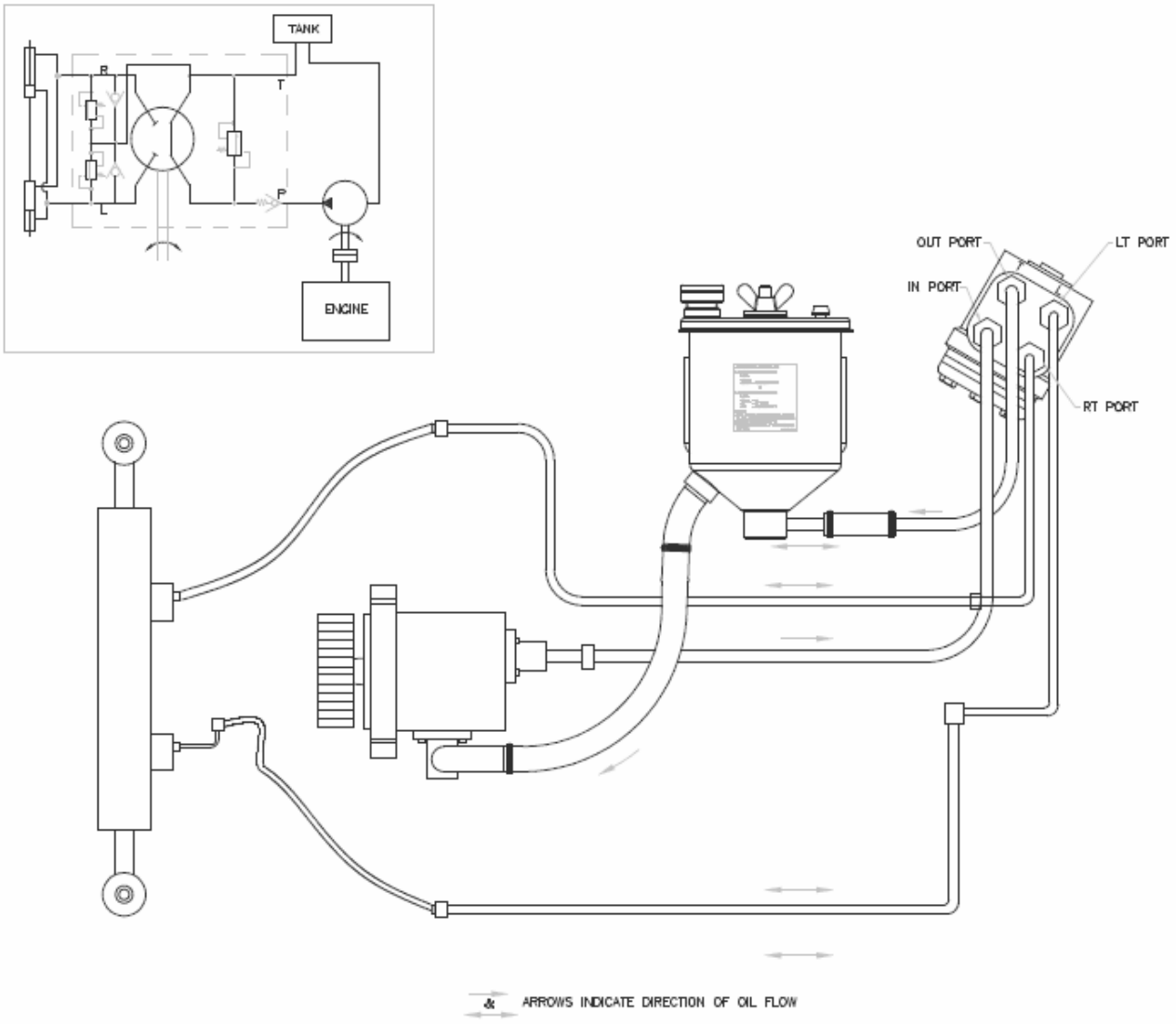


Fig 5

13A . 3 PROCEDURE FOR OIL FILLING AND AIR BLEEDING IN HYDROSTATIC STEERING UNIT.

CAUTION:

Do not remove the filler plug from the pump when the engine has been running for a long period as the oil in the pump will be hot and can cause severe burns if it comes into contact with the skin.

Air removal

Procedure

1. Remove the filler plug.
2. Fill the pump reservoir with clean oil to the plug level.
3. Replace the filler plug.
4. Start the engine and run it at 900 rev/min for approximately 30 seconds.
5. Rotate the steering to the left and right full lock positions.
6. Switch off the engine and refill the reservoir to the plug level.
7. Run the engine at 1200 rev/min.
8. Repeat procedure 5.
9. Leave the steering at full left lock and full right lock for approximately 10 seconds each time.
10. Repeat procedure 9, three times.
11. Switch off the engine and check all unions for leaks. If leaks are discovered, correct the fault and repeat the whole operation.
12. Tighten the filler plug to a torque of 106 lbf.inch (12 Nm).

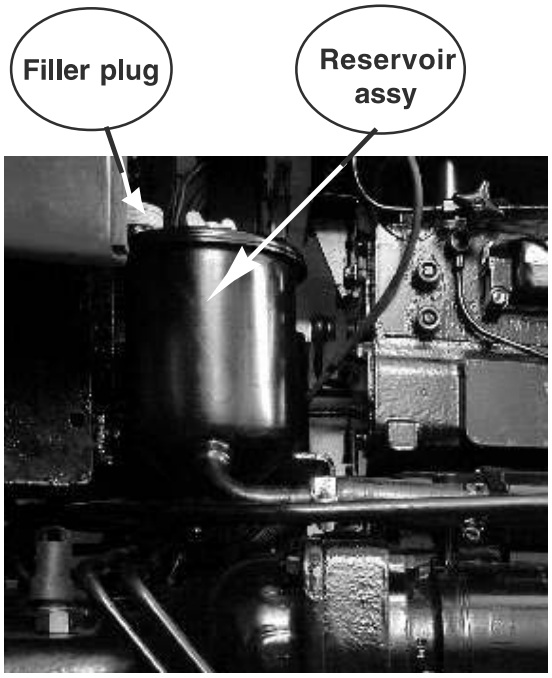


Fig. 6

Fig 7

STEERING PUMP:

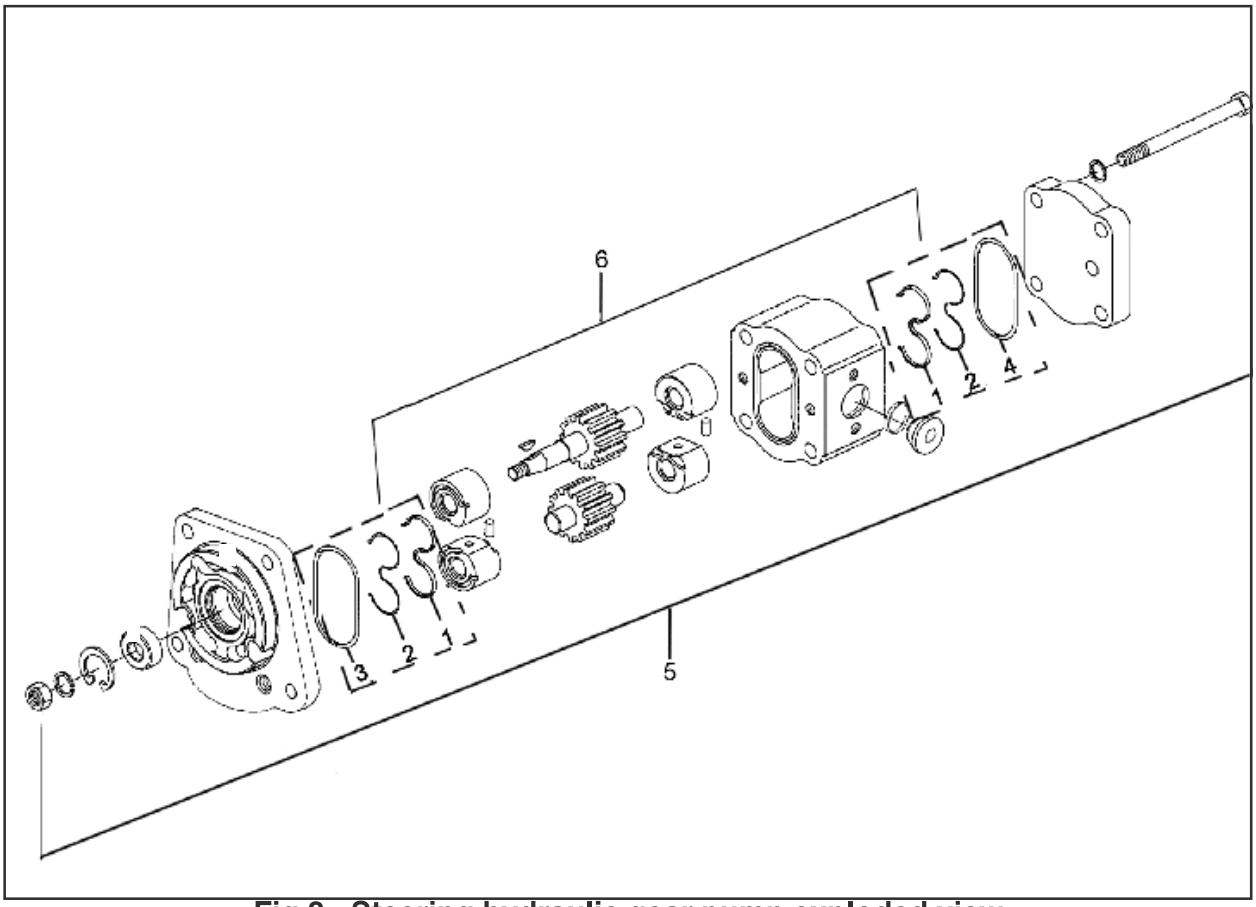


Fig 8 - Steering hydraulic gear pump exploded view

1.Seal ring 2.Support ring 3.Seal ring 4.Seal ring 5.MICO - Steering pump

6.Seal kit - Hyd gear pump (Includes items 1 to 4).

13 A . 4 - Steering pump:

Removal and refitment :

Removal:

1. Park the vehicle on level ground and apply parking brake .
2. Remove the ignition key from the tractor.
3. Disconnect the hydraulic pipe to the steering unit.
4. Disconnect the hydraulic pipe return to the pump.
5. Remove the four bolts securing the pump to the timing case.
6. With draw the pump assembly from the engine.
7. Remove the pump gear by using bearing puller.

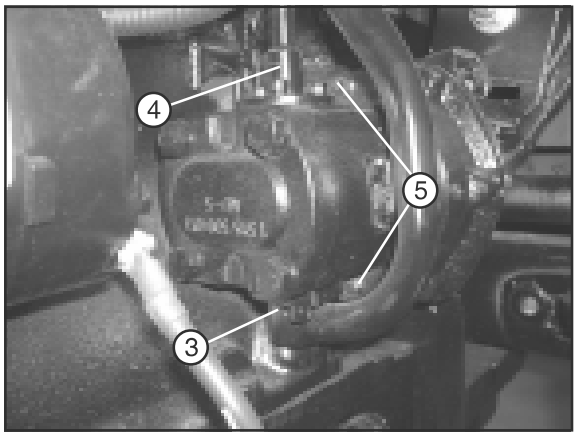


Fig 9

Refitment:

8. Reverse the procedure 1 to 7 except:

   a. Tighten the mounting bolts at a torque of 36 Nm (27 lbs.ft).

9. Refill the transmission oil and prime the system as described in section 13 A . 3 .

13A . 5 - Steering Pumps
Dis-Assembly & Re-assembly Procedure

1. Fix the fixture plate and fixture rod on the universal Vice.

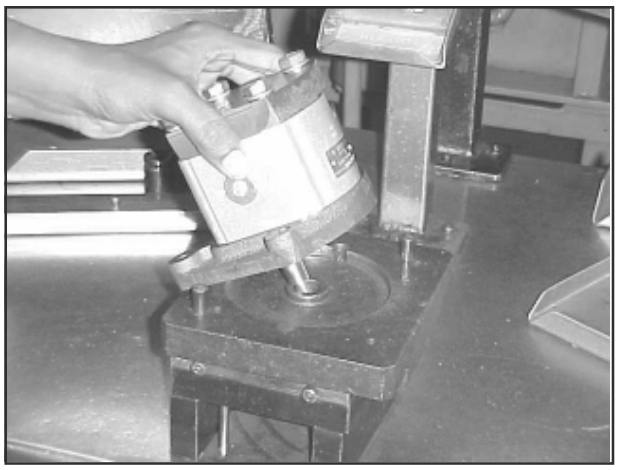
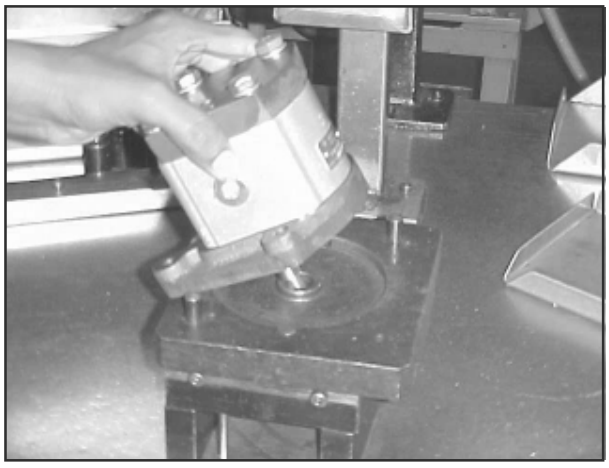


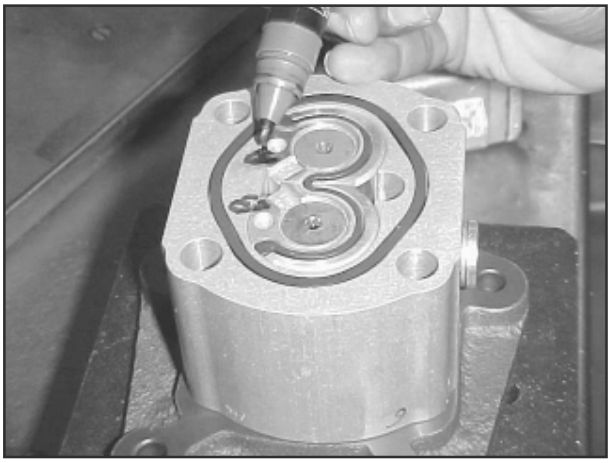
Fig 10

2. Mount the pump such that the drive gear shaft is towards the vice



3. Loosen 4 hex.bolts & remove bolts

Fig 11



4. Remove the end cover, mark A & B on bearing. bush On the end cover side.
   Bush on drive gear -A
   Bush on driven - B
   (this is to avoid inter-changing during Re- Assembly)

Fig 12

5. Remove housing along with bearing bushes & gears from mounting flange. Mark C & D on drive & driven side bush respectively
6. Remove all seals. Dis assemble bearing bushes and gears from the housing. Do not use hammer or force to separate the components.
7. Remove the mounting flange from the fixture plate. Mount it upside down. Remove circlip.
8. Remove the shaft seal
9. Clean all the components with a suitable cleaning media. Remove burrs from housing.

   Do not use file to deburr, use a sharp tool to scrape, such as a triangular scraper.

   Do not use cotton waste or cloth for cleaning/ wiping.
10. Examine the housing, bearing bush surfaces and the bearing sleeves for wear due to contamination etc.
11. If no severe wear is seen in the housing and bearing bushes, re-assemble the pump with new seals as per re-assembly procedure and use the pump.

    If the wear is severe, the pump can not be repaired.

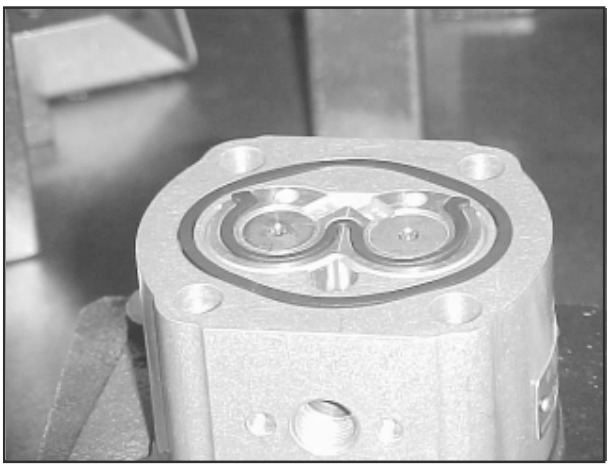


Fig 13

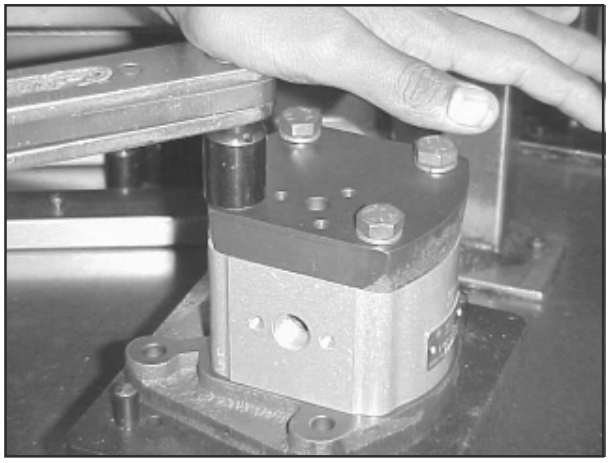


Fig 14

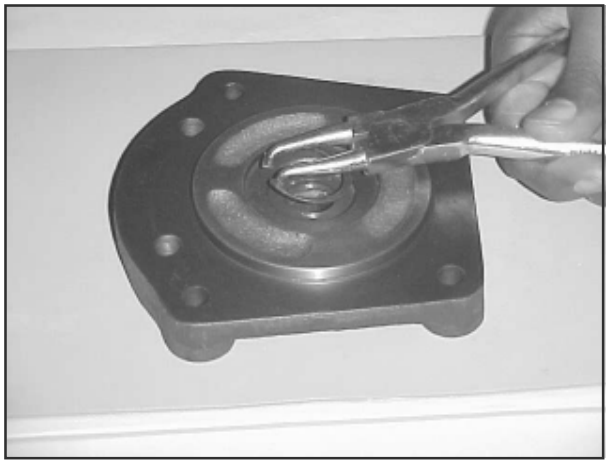


Fig 15

HYDRAULIC GEAR PUMPS

Re-assembly Procedure

1. Take care to see that bearing bushes and the gear shafts are assembled correctly (Observe the A,B,C, & D marks made earlier)

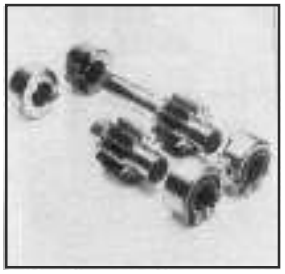


Fig 16

Fig 17

2. Assemble bearing bushes and gear shafts in the housing. See also the exploded view of the pump.

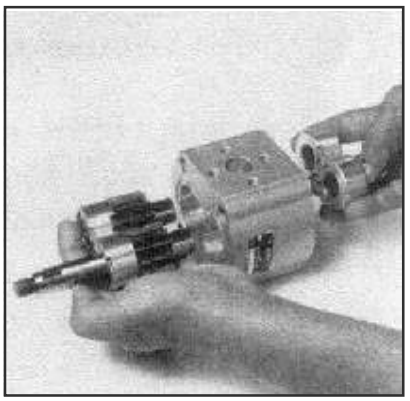


Fig 18

3. Place the assembly on the table with drive gear shaft projecting up. Fix the seals on the mounting flange side. Assemble the mounting flange.

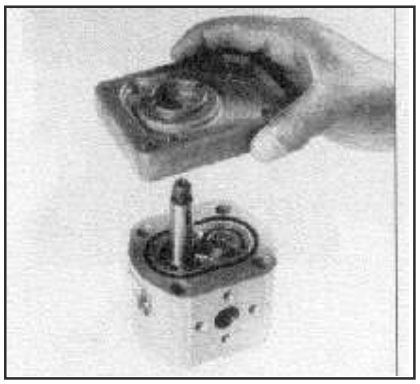


Fig 19

4. Hold the mounting flange, housing assembly and the bearing bushes together, turn and keep it back on the fixture plate with drive gear shaft towards the vice.

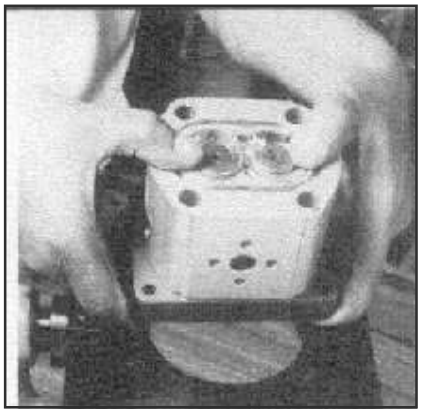


Fig 20

5. Fix the mounting flange using screws and nuts on the fixture plate. Assemble seals on the end cover side. Assemble the end cover.

6. Hand tighten the pump assembly with 4 hexagon. bolts and spring washers. Turn the fixture plate so that drive shafts is horizontal.

Fig 21

7. Insert the centering bush fully through the drive shaft, with appropriate mark on the bush towards the pump. Tighten the hexagon bolts. Remove the centering bush. This is to ensure alignment of shaft and the spigot.

Fig 22

8. Turn the fixture plate back to assembly position. Tighten 4 hex. Bolts further with a torque wrench. 37 + 7 lbf.ft. (50+10 Nm).

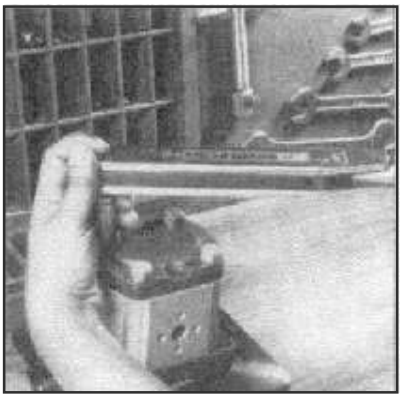


Fig 23

9. Remove pump from fixture plate, place the pump with drive shaft projecting upwards on the base of hand press. Using same centering bush and with appropriate mark on the bush towards the pump, press the shaft seal over the pump drive shaft.

10. Fix the circlip in the groove. Ensure circlip is located properly in the groove.

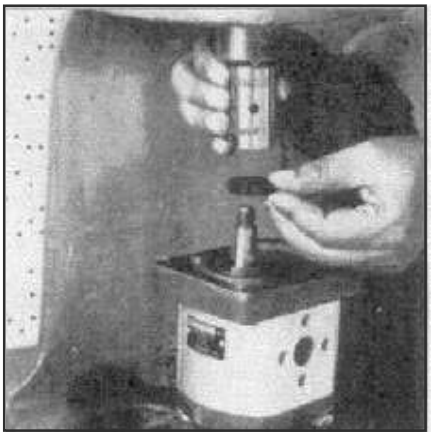


Fig 24

13A . 6 - HYDRAULIC GEAR PUMPS

Causes of Failure - Drive Faults

1. Distorted Key way due to a badly fitting Internal taper.
2. Fretting corrosion and broken drive shaft due to a badly fitting internal taper.
3. Sheared key due to :

   a) Badly fitting internal taper;

   b) Incorrectly tightened drive shaft nut.
4. Rear bushing of drive shaft badly worn due to end thrust from the pump drive.
5. Deep grooves in the pump body on the suction side (partly extending to the delivery side) due to severe contamination of Hydraulic oil.
6. Surface scoring of the pump body on the suction side (partly extending to the delivery side) due to contamination of the hydraulic oil - initial stage of failure.
7. Worm-like grooving in the outer surface of the bushing due to oil contamination.

8.1 Erosion due to oil contamination at the line of contact.

8.2 Concentric contamination grooving in root circle diameter.

9. Wear due to oil contamination. Gap to straight edge visible.
10. Scored bearing journal due to oil contamination.
11. Wear Zone due to contamination
12. Bronze showing through: Teflon coating worn away by scoring of gear wheel bearing journal. (oil contamination)
13. End seizure due to high temperature in the pump and bearing failure due to contamination wear. Advanced stage of failure. Similar effects are produced by Hydraulic overloading and oil temperature.
14. Severe bearing seizure and End seizure due to contamination wear and/or Hydraulic Overloading and/or oil over temperature. Total failure stage.
15. Suction side of pump body worn by the pump gear wheels due to bearing failure. Total failure stage.
16. Total failure of the bearing bushing and journal due to contamination wear an/or hydraulic overloading and/or oil temperature.

17.Support ring melted, seal hardened by oil over temperature.

18. Same as in 17, oil over temperature.
19. Cavitation attack of the end faces (air in oil)
20. Cavitation `attack of the pump body.

13A . 7 PROCEDURE FOR DISMANTLING HYDRAULIC STEERING UNIT FROM TRACTOR

1. Lift hood/Bonnet and disconnect battery terminal.
2. Remove steering cap and remove steering wheel.
3. Disconnect oil pressure pipe from gauge.
4. Remove fuel cut off knob and disconnect fuel cut off rod from Inst. Panel.
5. Disconnect Hour meter cable connection at meter end.
6. Remove hand throttle lever bracket .
7. Remove Inst. Panel mounting bolts on top and sides and lift Instrument panel from steering column and rest against fuel tank.
8. Remove reservoir hoses and drain oil into a clean container.
9. Remove the steering reservoir.
10. Disconnect pipes from P,T,L,R, points Fig. 1.
11. Disconnect pipes from 'T' joints Fig. 2.
12. Remove adapters from the P,T,L & R points.
13. Remove steering housing top cover (4 bolts) and disconnect 'L' bracket at rear of steering unit.
14. Remove steering unit with column by manipulating it out from the Inst. Panel.
15. Remove steering column mounting bolts and isolate steering unit.

    For assembly follow the reverse procedure of dismantling.

Fig 25

Fig 26

STEERING UNIT

Exploded view OSPJ 100 ON :

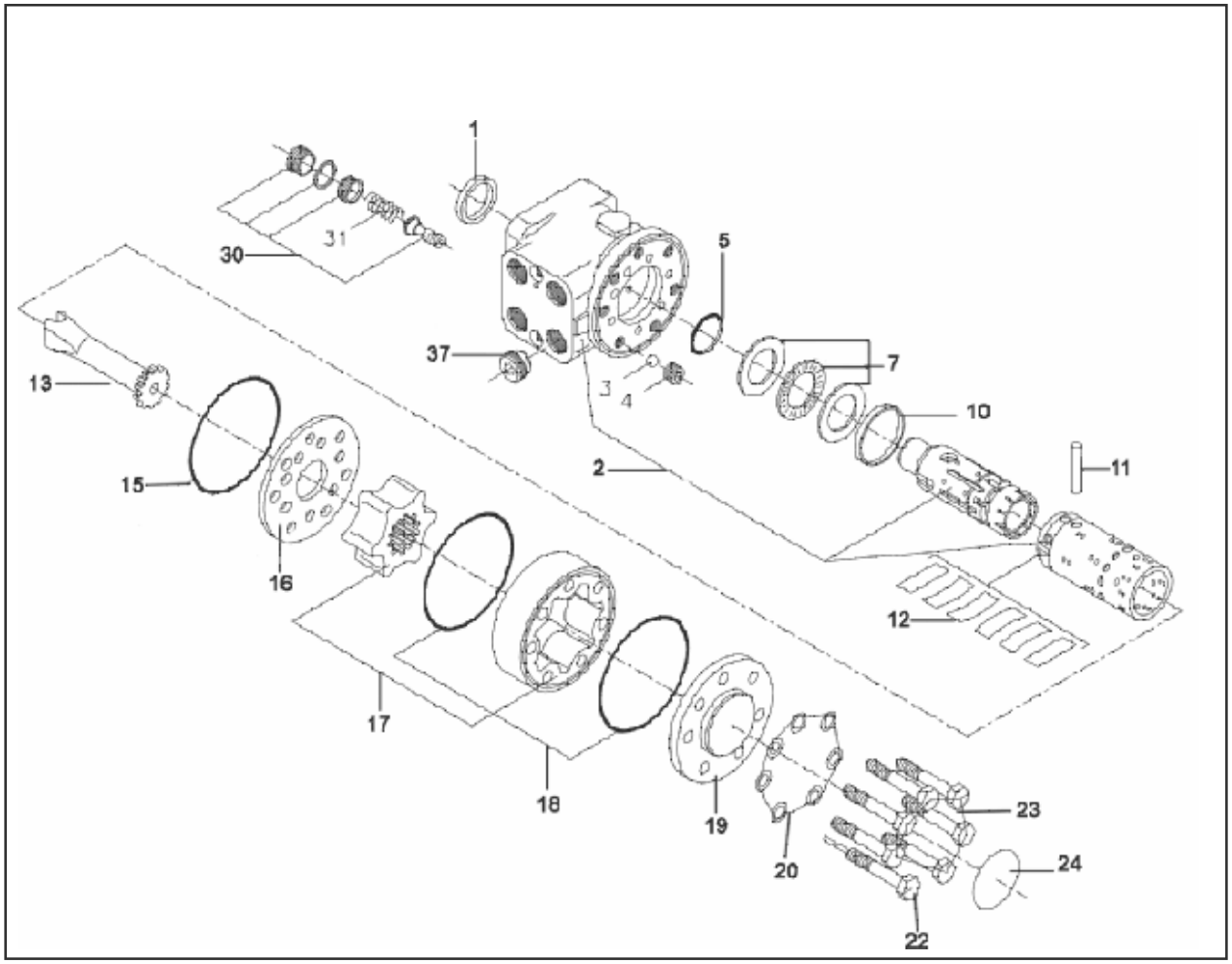
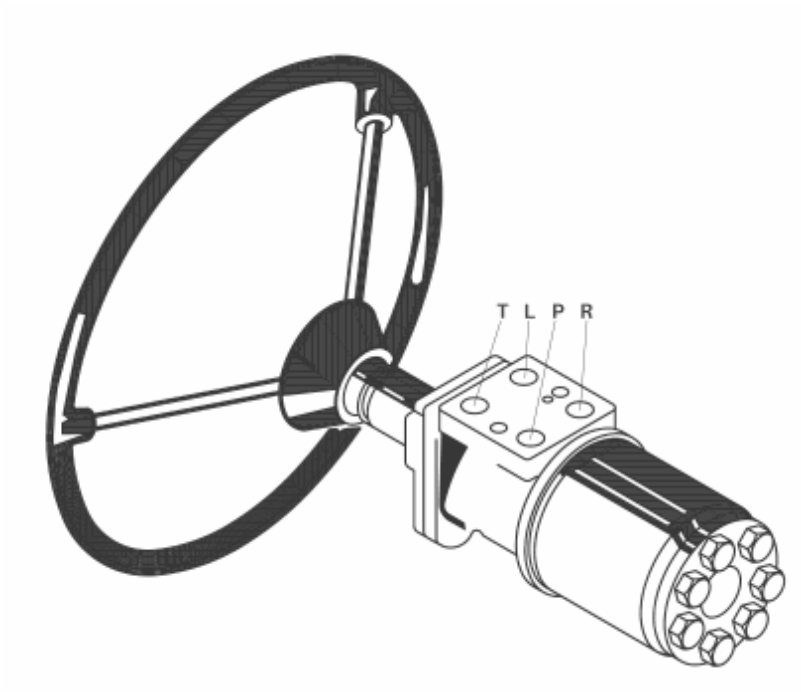


Fig 27

1	Dust seal ring.
2	Housing spool/sleeve.
3	Ball dia 8.5 mm.
4	Thread bushing.
5	O-ring/rotoglyd.
7	Bearing assly.
10	Ring.
11	Cross pin.
12	Set of springs .
13	Cardan shaft.
15	O-ring.
16	Distributor plate.
17	Gear wheel set.
18	O-ring.
19	End cover.
20	Washer .
22	Screw with pin.
23	Screw .
24	Name plate.
30	Pressure relief valve
31	Spring for relief valve
37	Check valve.

Max. tightening torque and hydraulic connections



L : Left Port
R : Right port
T : Tank
P : Pump

Fig 28

Screwed connection	Max : tightening torque daNm (ibf in)			
	With cutting edge	With copper washer	With aluminium washer	With O-ring
G 1/4	4 (350)	2 (180)	3 (270)	-
G 3/8	6 (530)	2 (180)	5 (440)	-
G 1/2	10 (900)	3 (270)	8 (700)	-
7/16-20 UNF	-	2 (180)	-	-
3/4-16 UNF	-	6 (530)	-	-
M12x1,5	4 (350)	2 (180)	3 (270)	2 (180)
M 18 x 1.5	7 (620)	2 (180)	5 (440)	5 (440)
M 22 x 1.5	10 (900)	3 (270)	8 (700)	7 (620)

13 A . 8 - STEERING UNIT

Overhauling

Dismantling of steering unit:

1. Dismantle steering column from steering unit and place the steering unit in the holding tool (SER278).Screw out the screws in the end cover (6-off plus one special screw).

Fig 29

2. Remove the end cover, sideways

Fig 30

3. Lift the gearwheel set (with spacer if fitted)off the unit.Take out the two o-rings.

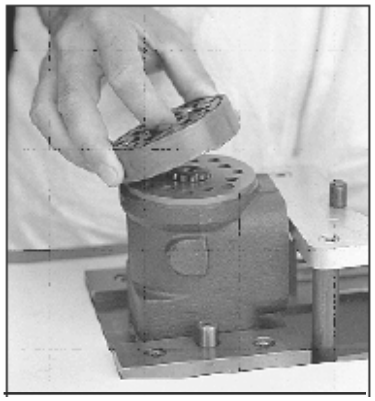


Fig 31

4. Remove cardan shaft.

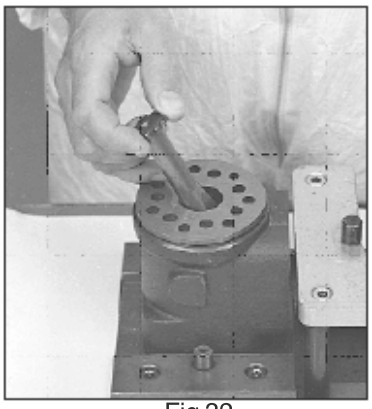


Fig 32

5. Remove distributor plate.

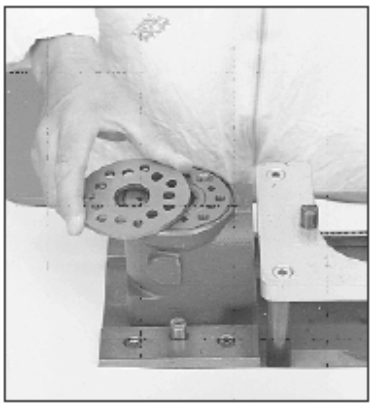


Fig 33

6. Screw out the threaded bush over the check valve.

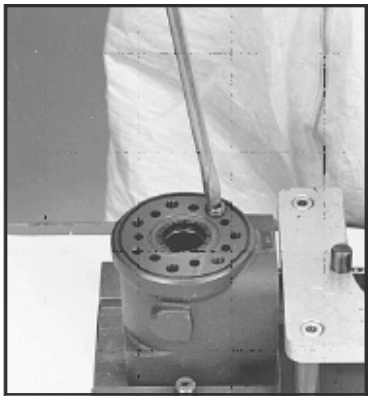


Fig 34

7. Remove 'O' -ring.

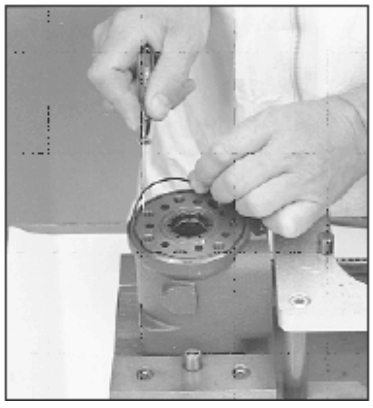


Fig 35

OSPJ 100 ON:

8. Shake out the check valve ball and suction valve pins and balls.

   Note:*On some pins in the OSPJ 100 ON there are two springs.Replace these pins prior to the reassembly.*

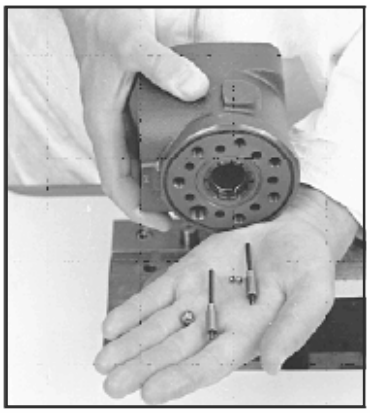


Fig 36

10. Take care to keep the cross pin in the sleeve and spool horizontal.The pin can be seen through the open end of the spool.Press the spool inwards and the sleeve,ring,bearing races and needle bearing will be pushed out of the housing together.

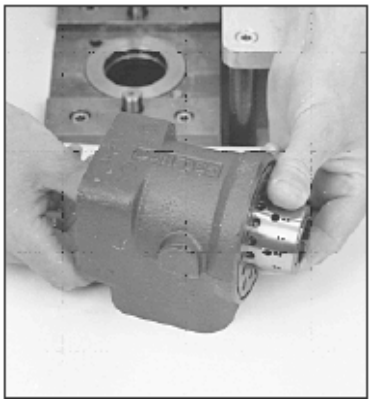


Fig 37

11. Take ring,bearing races and needle bearing from sleeve and spool.The outer (thin)bearingrace can sometimes “stick “ in the housing,therefore check that it has come out.

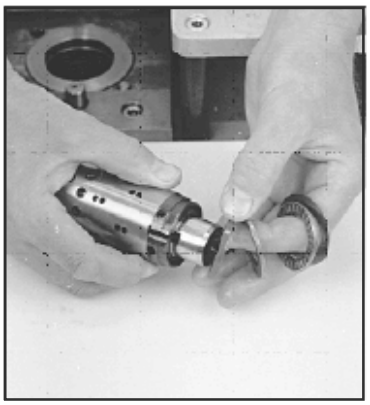


Fig 38

12. Press out the cross pin.Use the special screw from the end cover. Note next point / paragraph

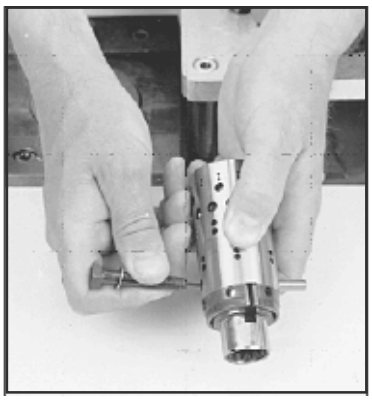


Fig 39

A small mark has been made with a soap stone on both spool and sleeve close to one of the slots for the neutral position springs.

If the mark is not visible,make a mark (non abrasive mark that can be wipe off) of your own on sleeve and spool before the neutral position springs are dismantled.

Fig 40

13. Carefully press the spool out of the sleeve.

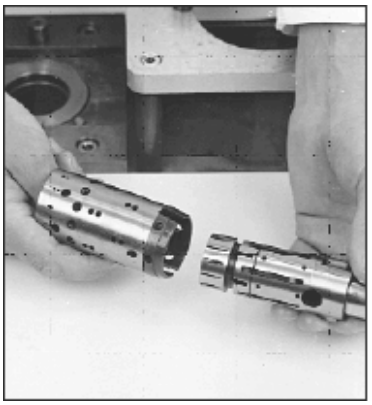


Fig 41

14. Press the neutral position springs out of their slots in the spool.

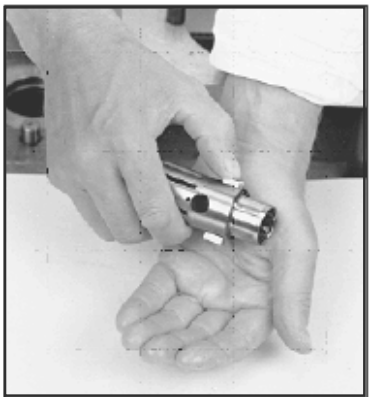


Fig 42

15. Remove dust seal and o-ring / kin-ring / RotoGlyd.

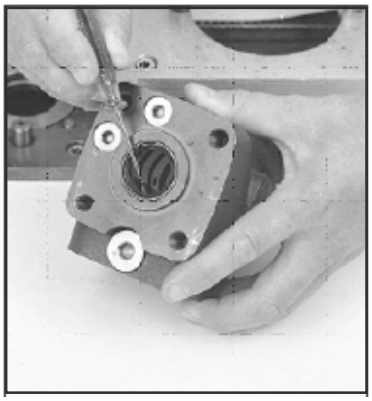


Fig 43

Dismantling the shock valves for OSPJ 100 ON

16. Remove plugs from shock valves using a 6 mm hexagon socket spanner.

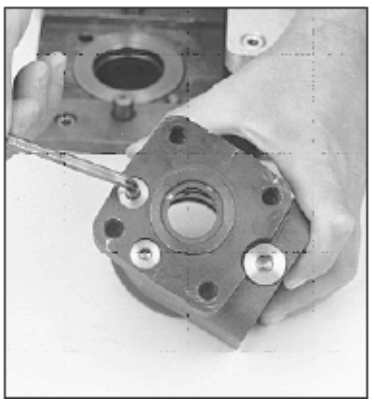


Fig 44

17. Remove seal washers (2-off).

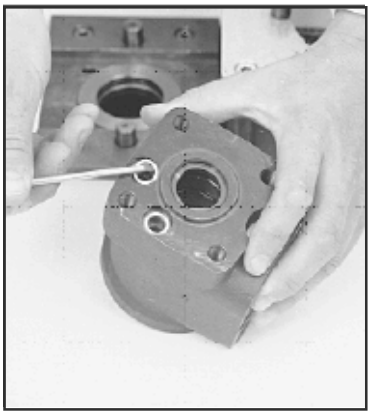


Fig 45

18. Unscrew the setting screws using a 6 mm hexagon socket spanner.

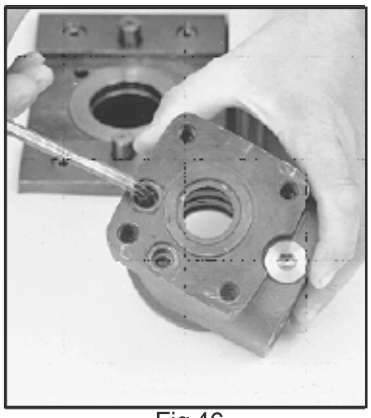


Fig 46

19. Shake out the two springs and two valve balls into your hand.The valve seats are bonded into the housing and cannot be removed.

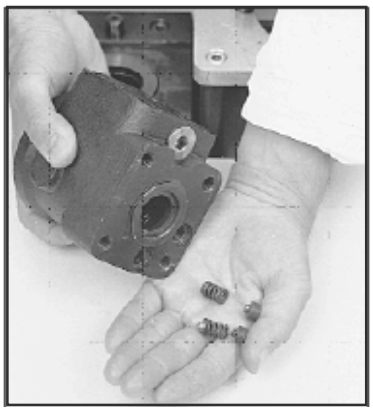


Fig 47

20. The shock valves are now dismantled.

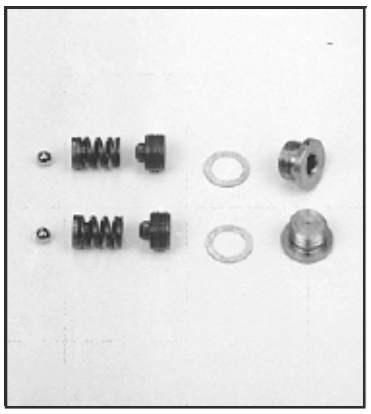


Fig 48

21. Screw out the plug using and 8 mm hexagon socket spanner. Remove seal washers.

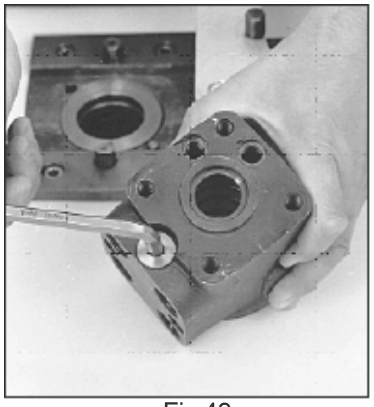


Fig 49

22. Unscrew the setting screw using an 8 mm hexagon socket spanner.

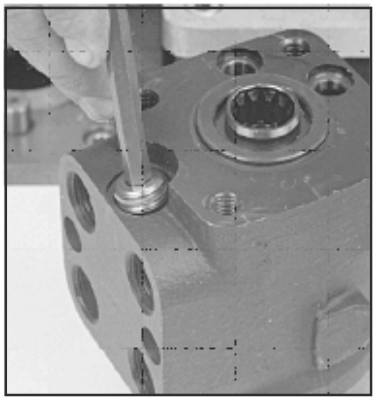


Fig 50

23. Shake out spring and piston.The valve seat is bonded into the housing and cannot be removed.

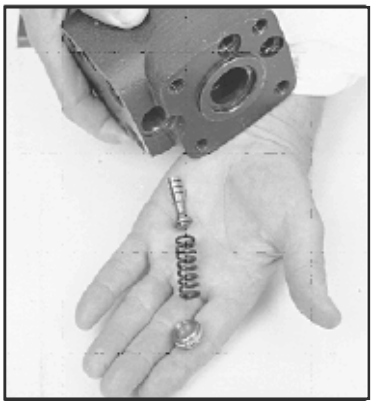


Fig 51

24. The pressure relief valve is now dismantled.

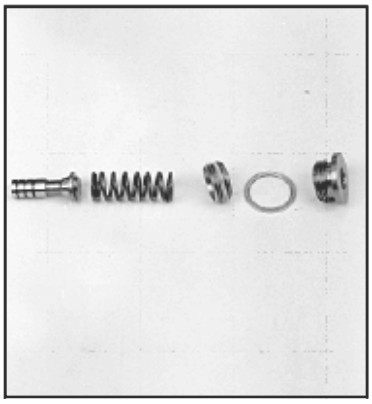


Fig 52

Dismantling the pressure relief valve (cartridge) for OSPJ 100 ON

25. Screw out the pressure relief valve using a 8 mm hexagon socket spanner.Remove the seal ring.If the valve is defective it must be replaced

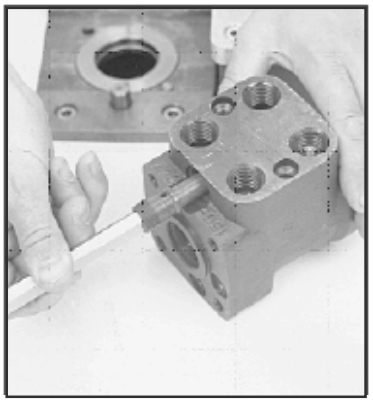


Fig 53

26. The pressure relief valve is now dismantled.

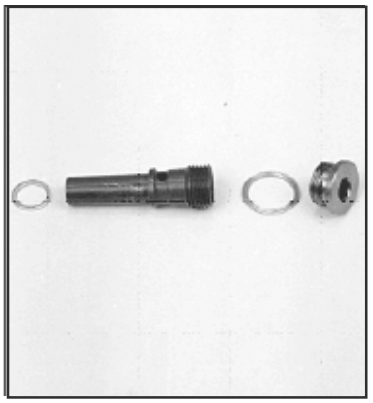


Fig 54

27. The steering unit OSPJ 100 ON is now completely dismantled.

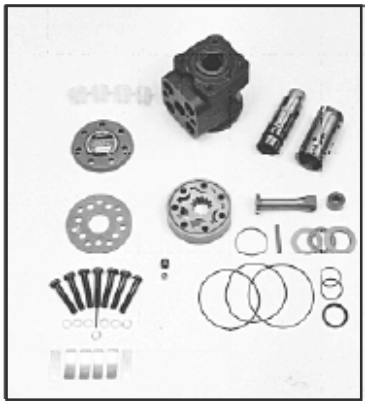


Fig 55

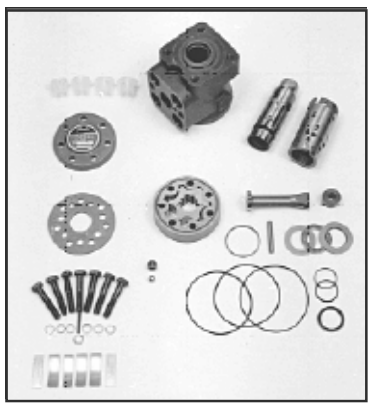


Fig 56

28. The steering unit OSPJ 100 ON is now completely dismantled. Replace these pins prior to the reassembly.(Refer arrow).

Cleaning

Clean all parts carefully in Shellsol K or similar parts cleaning solvent.

Inspection and replacement

Replace all seals and washers.Check all parts carefully and make any replacements necessary.

Lubrication

Before assembly,lubricate all parts with dextron oil.

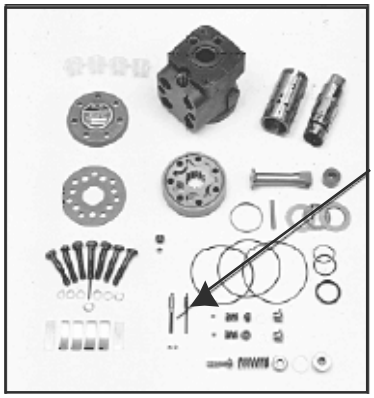


Fig 57

ASSEMBLING:

29. Place the two flat neutral position springs in the slot.

    Place the curved springs between the flat ones and press them into place.

Fig 58

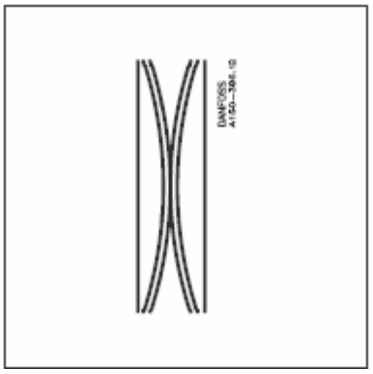


Fig 59

30. Line up the spring set.

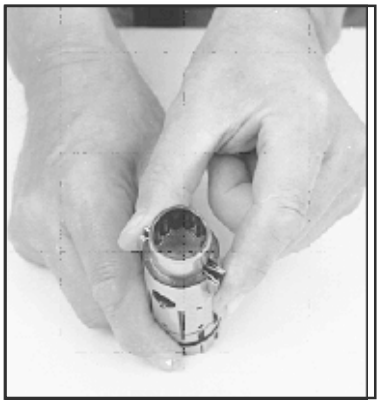


Fig 60

31. Guide the spool into the sleeve.Make sure that spool and sleeve for OSPJ 100 ON are placed correctly in relation to each other .

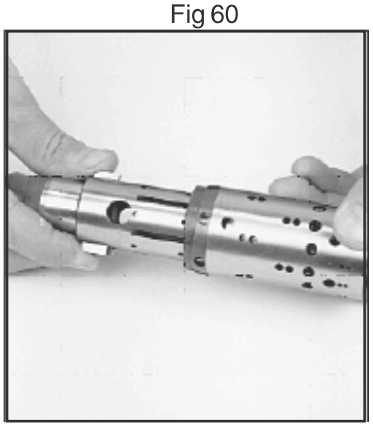


Fig 61

Note:

OSPJ 100 ON :

32. When assembling spool and sleeve only one of two possible ways of positioning thespring slots is correct.

There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots.Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.

Fig 62

OSPJ 100 ON :

33. Assemble the spool /sleeve and make sure the marks on spool and sleeve are opposite each other.

Fig 63

34. Press the springs together and push the neutral position springs into place in the sleeve.

Fig 64

35. Line up the springs and centre them.

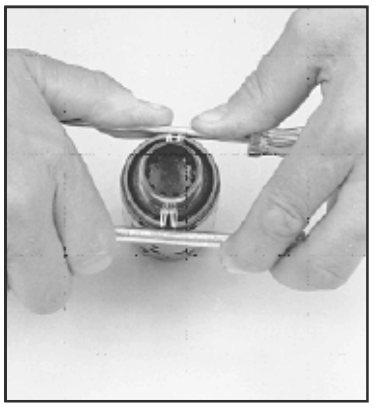


Fig 65

36. Guide the ring down over the sleeve.

Note:*The ring should be able to move - free of the springs.*

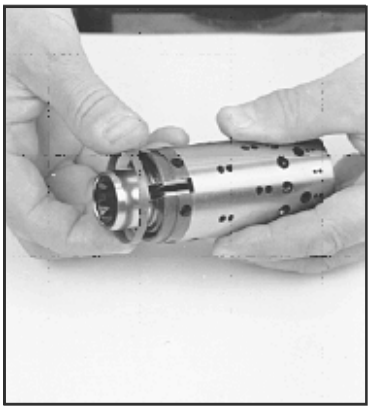


Fig 66

37. Fit the cross pin into the spool/sleeve.

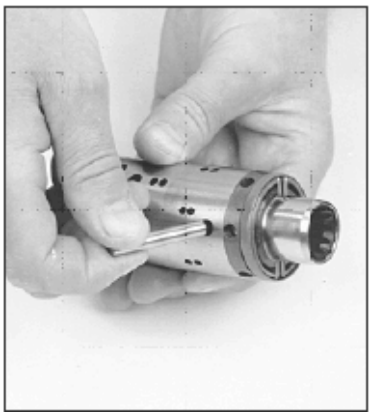


Fig 67

38. Fit bearing races and needle bearing as shown in drawing.

Assembly pattern for standard bearing

1 Outer bearing race

2 Needle bearing

3 Inner bearing race

4 Spool

5 Sleeve

* ***The inside chamfer on the inner bearing race must face the inner spool.***

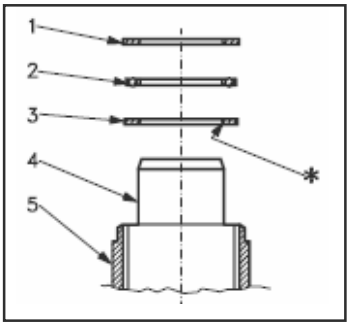


Fig 68

Installation instruction for 'O' rings

Turn the steering unit until the bore is horizontal.Guide the outer part of the assembly tool (SER279) into the bore for the spool/ sleeve.

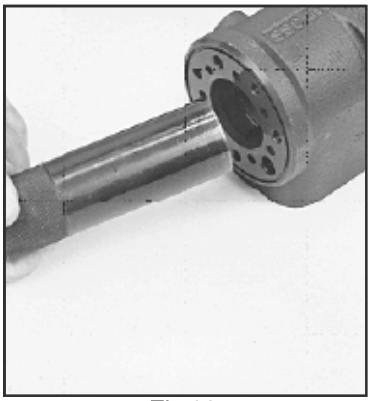


Fig 69

40. Grease o-ring and king-ring/roto Glyd with hydraulic oil and place them on the tool (SER280).

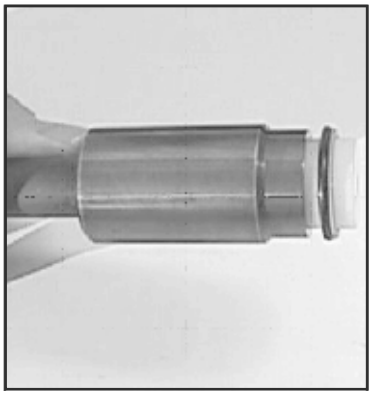


Fig 70

41. Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.

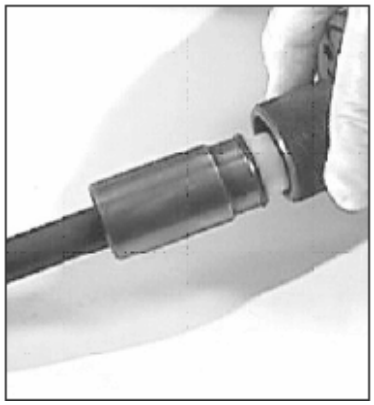


Fig 71

42. Press and turn the o-ring/kin-ring into position in the housing.

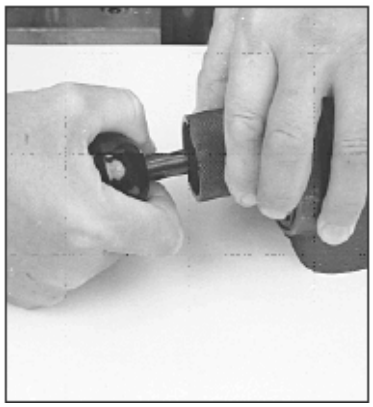


Fig 72

43. Draw the inner and outer parts of the assembly tool out of the steering unit bore,leaving the guide from the inner part in the bore.

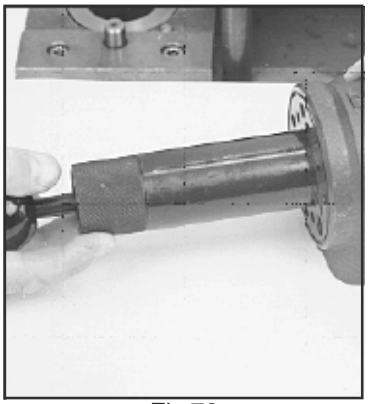


Fig 73

Installation instruction for Lip seal

44. Lubricate the lip seal with dextron oil and place it on the assembly tool (SER 282).

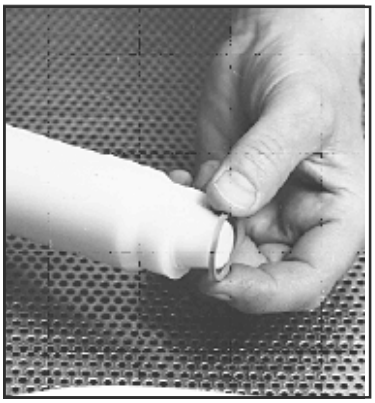


Fig 74

45. Guide the assembly tool (SER282) right to the bottom.

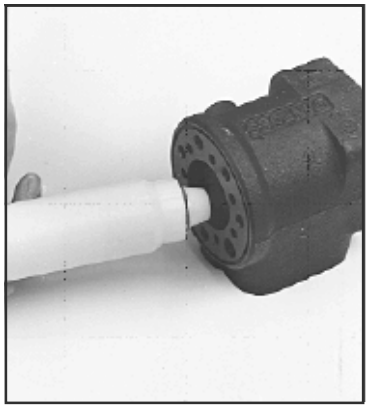


Fig 75

46. Press and turn the lip seal into place in the housing.

Fig 76

47. With a light turning movement,guide the spool and sleeve into the bore.

    Note: *Fit the spool set holding the cross pin horizontal.*

Fig 77

48. The spool set will push out the assembly tool guide (SER281).The o-ring and kin-ring/roto Glyd are now in position.

Fig 78

49. Turn the steering unit until the bore is vertical again.Put the check valve ball into the hole indicated by the arrow.

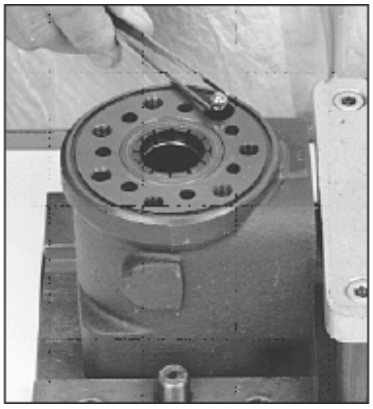


Fig 79

50. Screw the threaded bush lightly into the check valve bore.The top of the bush must lie just below the surface of the housing.

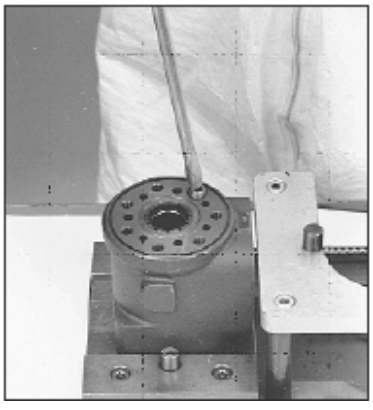


Fig 80

51. Place a ball in the two holes indicated by the arrows.

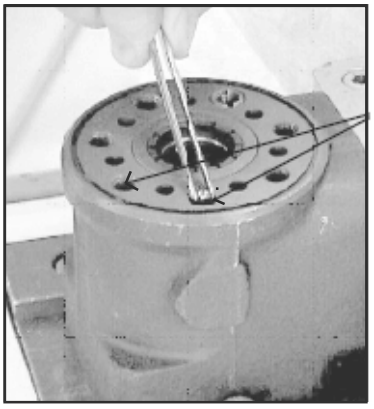


Fig 81

52. Place a new pin in the same two holes.

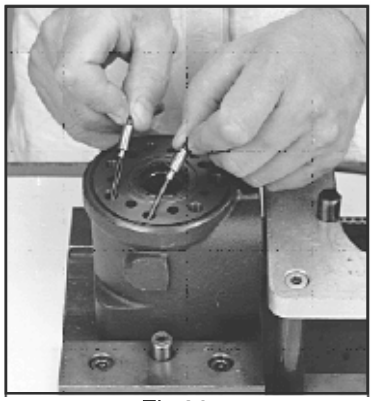


Fig 82

53. In some cases a spring has to be fitted (see page 23 No.8)on the pin before it is placed in the housing.

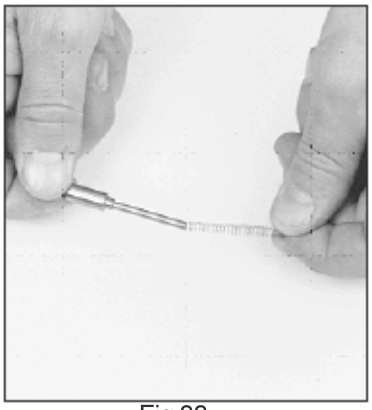


Fig 83

54. Grease the o-ring with mineral oil approx.viscosity 500 mm^2/s at 68°F (20°C).

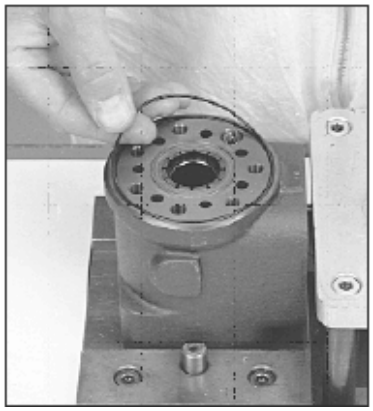


Fig 84

55. Place the distributor plate so that the channel holes match the holes in the housing.

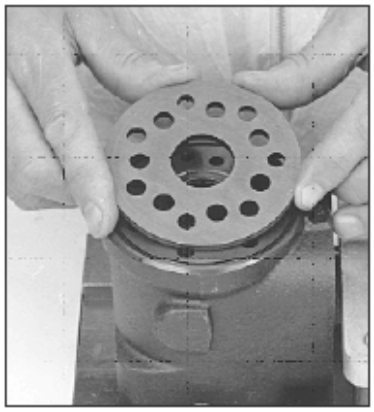


Fig 85

56. Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.

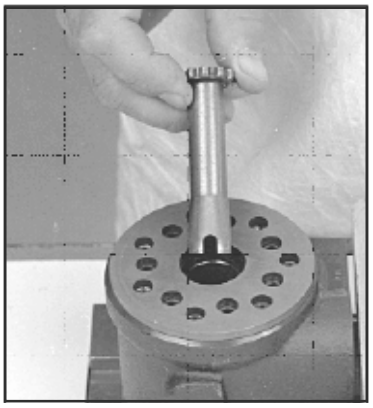


Fig 86

57. Place the cardan shaft as shown -so that it is held in position by the mounting fork by using (SER 283).

Fig 87

58. Grease the two o-rings with mineral oil approx.viscosity 500 mm 2 /s at 65°F(20°C) and place them in the two grooves in the gear rim.Fit the gearwheel and rim on the cardan shaft.

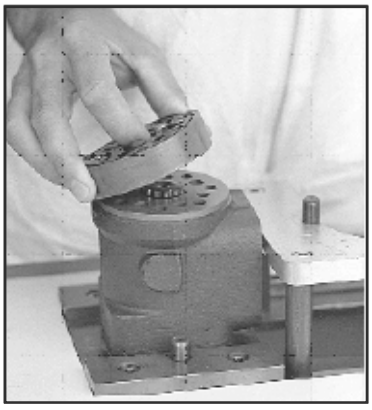


Fig 88

Important:*Fit the gearwheel (rotor)and cardan shaft so that a tooth base in the rotor is positioned in relation to the shaft slot as shown.Turn the gear rim so that the seven trough holes match the holes in the housing.*

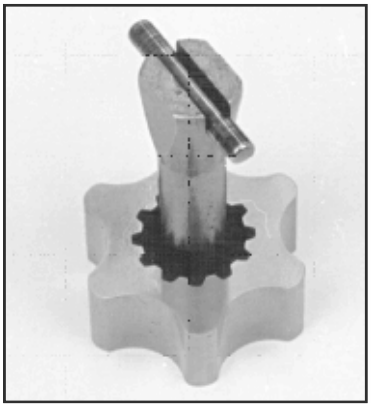


Fig 89

59. Fit the spacer,if any.

Fig 90

60. Place the end cover in position.

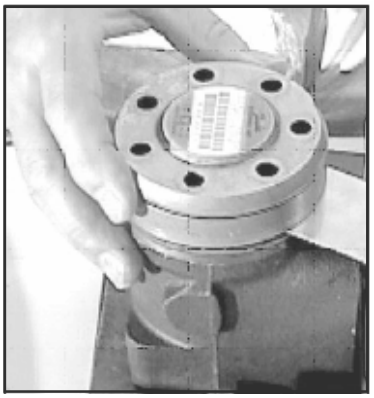


Fig 91

61. Fit the special screw with washer and place it in the hole shown.

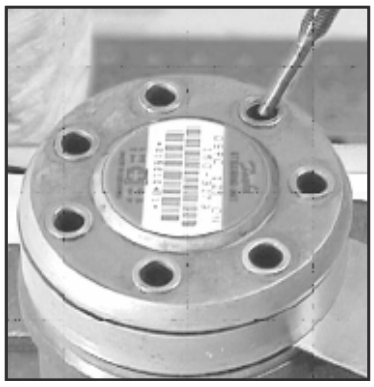


Fig 92

62. Fit the six screws with washers and insert them.Cross-tighten all the screws and the rolled pin with a torque of 22 lbf.ft (30 Nm).

Fig 93

Assembly of pressure relief valve for OSPJ 100 ON

63. Fit the piston.

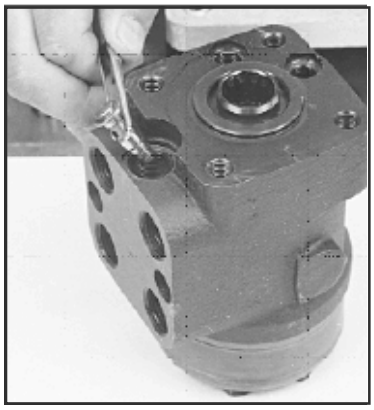


Fig 94

64. Fit the spring.

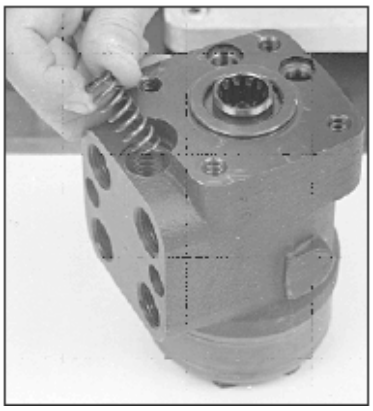


Fig 95

65. Screw in the setting screw with an 8 mm hexagon socket spanner. Make the pressure setting on a panel or the vehicle.

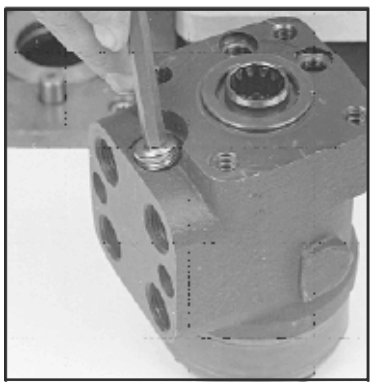


Fig 96

66. Screw plug with dust seal into the housing using an 8 mm hexagon socket spanner. Tightening torque 37 lbf.ft (50 Nm).

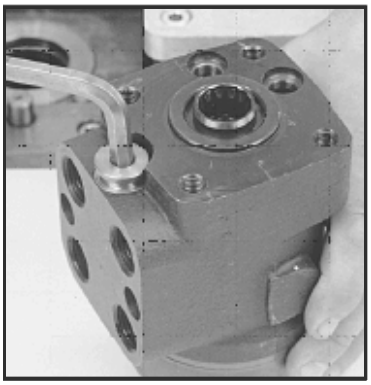


Fig 97

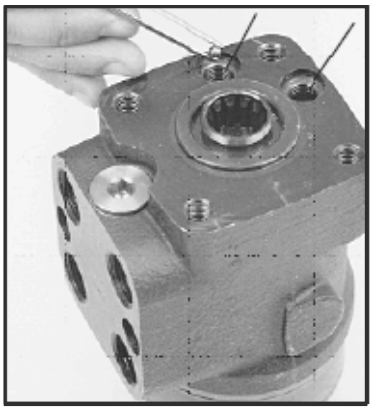


Fig 98

Assembly of shock valves

67. Put a ball in the two holes indicated by the arrows.

68. Place springs and valve cones over the two balls.

Note:*The blue spring applies to setting range 90-180 bar (1305 - 2610 psi).The untreated spring applies to setting range 170-260 bar (2465 -3770 psi).*

Fig 99

69. Screw in the two setting screws using a 6 mm hexagon socket spanner.Make the pressure setting on a panel or the vehicle.

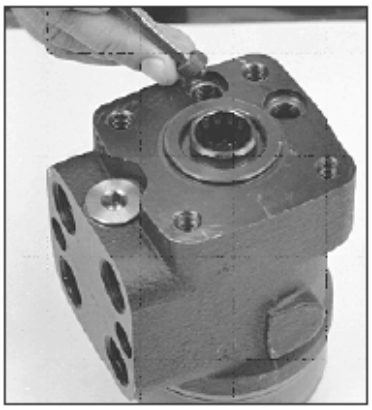


Fig 100

71. Screw plug with seal ring into the two shock valves and tighten them with a torque of 22 lbf.ft (30 Nm) using a 6 mm hexagon socket spanner. Steering unit type OSPJ 100 ON is now assembled.

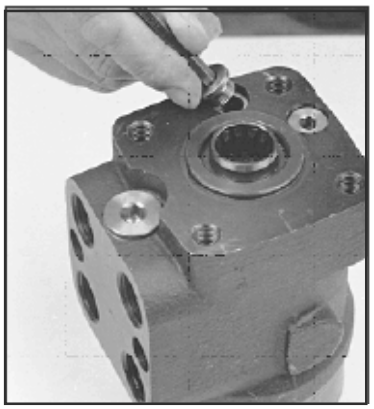


Fig 101

72. Place the dust seal ring in the housing. With the OSPJ 100 ON the dust seal ring must be placed only after the pressure relief valve and shock valves have been fitted.

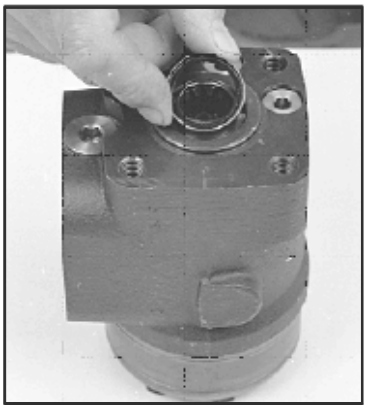


Fig 102

73. Fit the dust seal ring in the housing using special tool SER 284 and a plastic hammer.

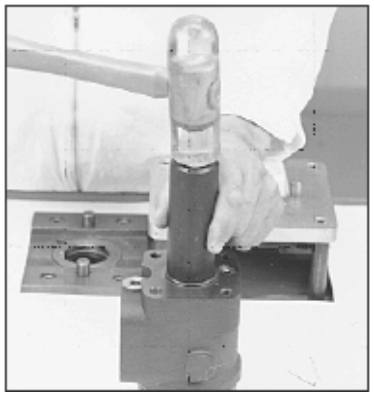


Fig 103

74. Press the plastic plugs into the connection ports.Do not use a hammer.

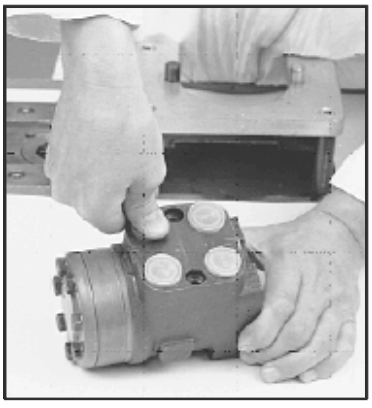


Fig 104

13 A . 9 - DRAG LINKS AND TIE RODS

Overhaul

Dis-assembly

1. Remove the nuts securing the ball joints to the drop arm or spindle arm.
2. Release the ball end by hitting the side of the arm while supporting the opposite side with a block of metal or heavy hammer.
3. Loosen the bolt and locknut and withdraw the ball end.
4. Loosen the clamp bolt and unscrew the ball end.

Examination

Check the ball ends for wear, replacing any defective components. These are safety critical components.

Re-assembly

5. Reverse procedures 1 to 4 except:

   a. Tighten the nuts and bolts to the following torque:

   i. Ball joint nuts 90 lbf.ft (122 Nm).

   ii. Clamp bolt 35 lbf.ft. (47 Nm).

   iii. Track adjustment bolt 35 lbf.ft.(47 Nm).

   b. Reset the front wheel toe in, see operation 7A . 2 .

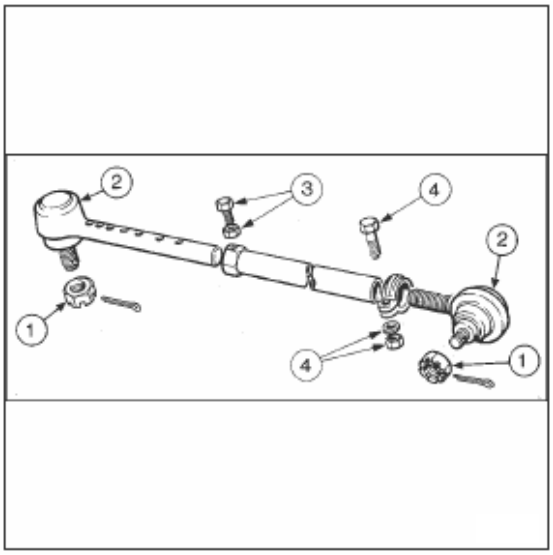


Fig 105

13A . 10 - STEERING RAMS

Removal and refitment

Removal

1. Disconnect both hydraulic pipes to the steering ram.
2. Remove the 'R' clip from the inner pivot pin.
3. Remove the split pin.
4. Remove the slotted nut.
5. Drive the ball joint taper out of the steering arm.
6. Remove the steering ram assembly.

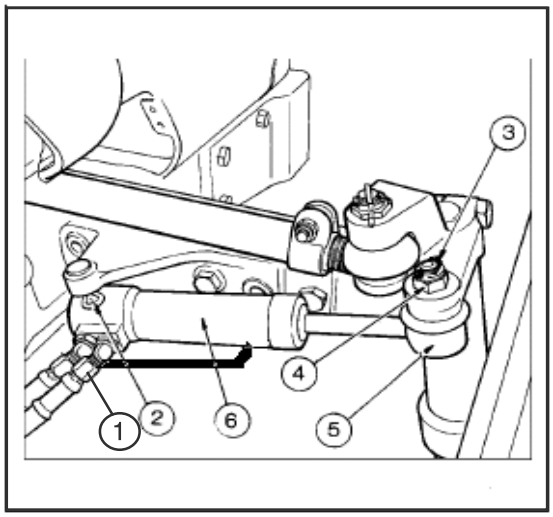


Fig 106

Refitment.

7. Reverse procedure 1 to 6 except:

   a. Tighten the ball joint nuts to a torque of 70 lbf.ft (95 Nm) for M16 UNF ball end nuts.

   b. Refill the reservoir.

13 A . 11 Steering cylinder

over hauling

Work condition:

It is a must that the system be kept free of dirt or foreign matter in the oil circuit. Cleanliness in servicing this power steering cylinder is absolutely essential.

If it is necessary to disassemble the cylinder, make sure a clean table or work bench is used.

Outside dirt should be cleaned off before disconnecting lines and port holes should be plugged immediately after disconnecting lines.

Finish cleaning off outside dirt before placing on work bench.

When disassembled,parts should be cleaned only in clear clean petroleum base solvent and blown dry with clean dry air. Other solvents may cause deterioration of seals. Avoid wiping parts with cloth.

Warning: It is imperative that the instruction in this manual are followed to the letter.Failure to observe the procedures set out in this manual may result in loss of steering.

Dismantling:

1. Clean the cylinder by wiping the exteriors completely. Open the ports.Hold the cylinder body in one hand and move the piston rod back and forth to purge oil from the cylinder.
2. Hold the cylinder body in bench vise as shown in figure.
3. Unscrew the head end cover from the cylinder body using SER 298.

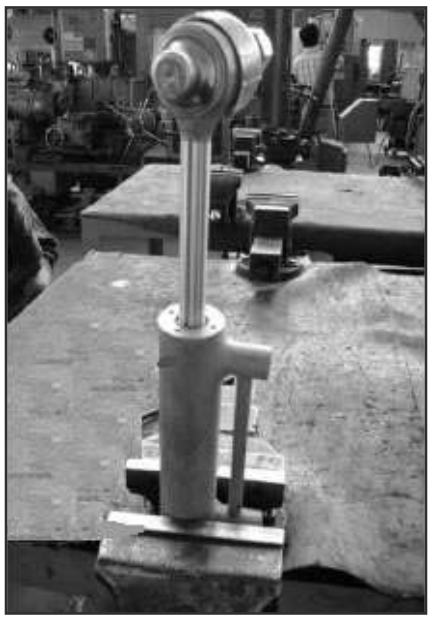


Fig 107

Fig 108

4. Pull out the piston rod sub assembly after completely unscrewing head end cover.

Fig 109

5. Remove piston seal ring using a blunt lever / pry bar.

Fig 110

6. Remove piston seal o-ring using a small lever.

Fig 111

7. Unscrew the grub screw using suitable allen key

Fig 112

8. Hold the piston in bench vise with proper packing and rotate the ball joint to unscrew the piston.

Fig 113

9. Remove the head end cover from piston rod by sliding.

Fig 114

10. Remove the o-ring from head end cover.

Fig 115

11. Remove the rod seal using a small bent lever / pry bar.

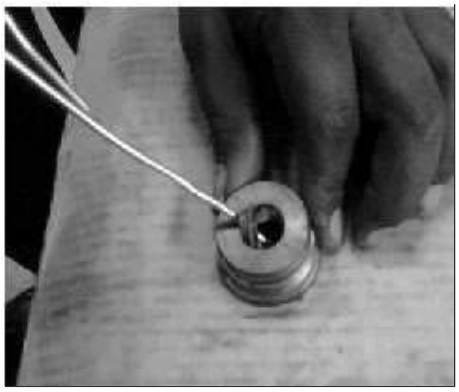


Fig 116

12. Remove the rod wiper using a small bent lever / pry bar.

Fig 117

Cleaning:

Clean all parts carefully using clean and clear petroleum based solvent.

Inspection and Replacement:

All seals.o-rings and washers must be replaced.

Check all the parts carefully for any damage or deterioration.If necessary replace the parts with new ones. When in doubt,replace the part.

Lubrication:

Prior to assembly,lubricate all the parts with clean dextron oil.

Refitment:

1. Insert O-ring into piston bore.

Fig 118

2. Insert rod seal into head end cover bore front side groove.

Fig 119

3. Insert rod wiper into head end cover bore bottom side groove.

Fig 120

4. Ensure that all seals are properly seated in the respective grooves.

Fig 121

5. Assemble 'O' ring onto the groove on outside diameter of head end cover.

Fig 122

6. Insert head end cover onto the piston by sliding.

Fig 123

7. Assembling piston and piston rod.

Fig 124

Hold the piston without seal in bench vise with proper care such that the outside diameter does not get damaged.

Fig 125

Apply low strength anaerobic thread locking sealant onto the grub screw and insert in to tapped hole in piston face and tighten fully using suitable allen key.

Fig 126

8. Assemble piston seal O-ring onto piston seal groove.

Fig 127

9. Assemble piston seal ring above the O-ring.

Fig 128

10. Keep piston rod sub assembly separately.

Fig 129

11. Apply oil on all the parts , clamp the tube subassembly at bottom side on the bench vise and insert piston rod sub assembly and ensuring it slides smoothly.

Fig 130

12. Push piston rod subassembly into the tube until it is fully home and that head end cover enters the tube bore.

Fig 131

13. Properly engage the head end cover thread with the thread in the tube and tighten completely by using SER 298.
14. Now the cylinder is ready for testing.

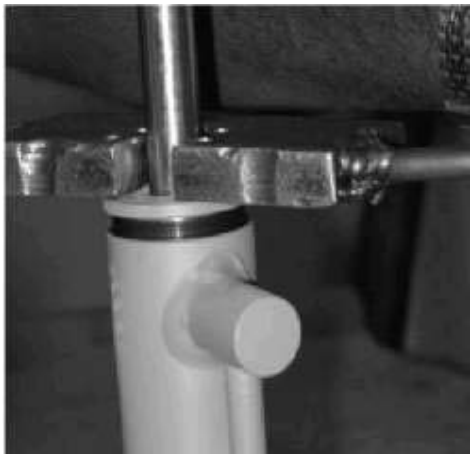


Fig 132

Testing:

1. Hold the cylinder in horizontal position. Remove the port plugs. Move the piston rod in and out five times. The rod should move smoothly.
2. Clamp the cylinder horizontally in a bench vise. Ensure both cylinder ports are open. Connect the rear port of the cylinder to a hand pump fitted with a pressure guage. Actuate the pump by stroking till the piston rods extends out fully. Actuate the pump further till the pressure reaches 125 bar (1812 psi). Hold in that position for 2 minutes. There should be no oil seepage from the front port of the cylinder.
3. Repeat the above exercise by connecting the pump to the front port of the cylinder.There should be no oil seepage from the rear port and head end cover of the cylinder.